

### Research Summary – Wheelchair Skills Test (WST, WST-Q) – Wheeled Mobility

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
<a href="#">Kirby et al.</a> 2016  Cross-sectional survey N=117	N=117, 100 male Median age (IQR): 39 (29.3-49.8) Median BMI (IQR): 25.8 (21.8-30.5) 90 paraplegia, 26 tetraplegia	Correlation of WST capacity with WST-Q capacity: $\rho=0.55$		
<a href="#">Rushton et al.</a> 2016  Test-retest study assessing measurement properties of WST-Q for power users	N=72 (36M); Mean age =60.7 (7.3) years (range 50-77). <b>Note: Sample only 19% SCI</b>	Concurrent Validity Mean scores (SD) and correlations with WST-Q: LSA (assisted life space) 2.0 (0–5); $r=0.47$ , $p<0.001$ WheelCon-P (/100) 76.6 (13.5; $r=0.47$ , $p<0.001$ WST (/100) 80.1 (10.5); $r=0.65$ , $p<0.001$	The one-month test–retest reliability $ICC_{1,1}$ was 0.78 with a confidence interval of 0.68–0.86.	The SEM of 5.0 and the SRD of 6.2 represent the minimal change in WST-Q score that reflects a meaningful change beyond measurement error for a group and an individual respectively
<a href="#">Pradon et al.</a> 2012  Methodological study	N=40 (30M, 10F) Mean age: $36.9\pm11.2y$ Mean (range) 79.8 (1- 360) months in rehabilitation	Spearman's rank correlation coefficient between Wheelchair Skill Test score and the:	The intraclass correlation coefficients (ICC) evaluating test- retest reliability for	The total group of participants obtained a mean WST score of 83.8% (SD 16.6%) (range 47.0–100.0%), a

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N=40	SCI patients  Tetraplegic (C6-C7): 7 High paraplegic (T1-T9): 15 Low paraplegic (T10-L3): 18	<ul style="list-style-type: none"> <li>- maximal velocity (<math>V_{max}</math>) = 0.72;</li> <li>- Spontaneous velocity (<math>V_{spont}</math>) = 0.57;</li> <li>- Slalom time (<math>S_{time}</math>) = -0.75</li> </ul> <p>(<math>p &lt; .05</math> for all)</p>	<p><math>V_{max}</math>, <math>V_{spont}</math>, and <math>S_{time}</math> were 0.94, 0.84, and 0.88, respectively.</p> <p>The ICC evaluating inter-rater reliability for <math>V_{max}</math>, <math>V_{spont}</math>, and <math>S_{time}</math> were 0.92, 0.92, and 0.95, respectively.</p>	mean $V_{max}$ of 6.91 km/h (SD 2.10) (range 3.6–11.7), a mean $V_{spont}$ of 4.74 km/h (SD 1.21) (range 2.6–7.5) and a mean $S_{time}$ of 60.4 s (SD 29.6) (range 25.0–153.0).
<a href="#">Lemay et al.</a> 2011  Cross-sectional study N=54	N=54 (41M, 13F) Mean (SD) age: 46.7 (12.8) Manual wheelchair experience: 16.0 (11.2) years  SCI patients  Tetraplegic (C4-C8): 14 (25.9%) High paraplegia (T1-T6): 10 (18.5%) Low paraplegia (T7-L2): 30 (55.6%)	Correlations between WST total performance score and: Wheeled distance per day: 0.36 ( $p < .01$ ) Wheeled speed per day: 0.22 (ns – $p > .05$ ) Age: -0.32 ( $p < .05$ ) Manual wheelchair experience: -0.15 (ns – $p > .05$ ) There was a significant correlation between WST total performance score and mobility ( $r = 0.36$ ,		Mean (SD) WST total performance score for different subgroups: All participants: 80.7±11.8 Tetraplegia: 72.1±7.9 High paraplegia: 82.8±9.1 Low paraplegia: 84.0±12.4  55.6% of participants scored over 80% (80% is empirically considered the cut-off for distinguishing people with advanced

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		p<.01), which suggests that greater MWC skills are slightly associated with higher mobility at home and in the community in terms of daily wheeled distance. The correlation between WST total performance score and daily wheeled distance did not remain significant when controlled for age (partial $r=0.26$ , $p=.07$ ). A moderate correlation between age and WST total performance score was also observed ( $r=-0.32$ , $p<.05$ ).		MWC skills (mainly skills required to control wheelies)) - 28.6% of the participants with tetraplegia (4 out of 14) reached or exceeded the 80% cut-off, suggesting advanced MWC skills.
<a href="#">Hosseini et al.</a> 2012  Cross-sectional multisite study	N=214; Mean age = 38.8 (12) years; Mean time since injury = 11.7 (11) years (range = 0.9-50 years); Level of injury = C3-L5, 72%	Predictive Criterion Validity  WST version 4.1 score predicted CHART score, Satisfaction		

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N=214	with paraplegia, 28% with tetraplegia	with Life Scale score, and self-perceived health status on multiple linear regression ( $p<0.05$ )		
<a href="#">Lindquist et al.</a> 2010  Test-retest design with 1-2 weeks in between testing. N=11	N=11 (9M) Mean (SD) Age: 41.2±16.2 9 SCI, 1 stroke, 1 Arteriovenous malformation No info on SCI injury types Mean (range) overall wheelchair experience 9.7(1-37) years		Interrater – ICC=0.86 $p<0.001$ Intrarater – ICC = 0.95 $p<0.001$ Test-retest – ICC = 0.90 $p<0.001$	
<a href="#">Mountain et al.</a> 2004  Within participant comparisons – WST and WST-Q for Manual wheelchair users	<b>Only 20% SCI</b>  Participants: N=20 manual wheelchair users (12M, 8F), Age: 64.3±13.6, 7 Amputees, 4 musculoskeletal disorders, 4 SCI, 5 stroke and acquired brain injury	Concurrent Validity - WST highly correlated with the WST-Q ( $r=0.91$ )		

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N=20				
<a href="#">Kirby et al.</a> 2002  Methodological pilot study with within-subject comparisons N=24	N=24 wheelchair users (16M, 8F) Age: 59±19 <b>Note: Only 12% SCI</b> 11 amputees, 4 stroke, 3 musculoskeletal disorders, 3 with SCI, 3 with neuromuscular disorders Inpatients and Outpatients	The participants' occupational therapists unanimously endorsed 30 (91%) of the 33 WST skills.  The therapists felt that 13 of the 21 subjects improved and 8 had not changed between tests 1 and 2. The paired t tests between the subjects' total raw WST scores on test 1 and 2 showed a mean improvement of 2.1± 5.7 (p<.05). Improved: 3.2±5.9 No change: 0.5±5.2 (p=.15)	$\rho = 0.65$ (P=.001)  Intra-rater: $\rho = 0.96$ (P<.001)  Inter-rater: $\rho = 0.95$ (P<.001)	WST 1 mean (SD) score: 36 (8) WST 2 mean( SD) score: 38 (10)

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		<p>Mean total WST scores 39.8±6.7 (n.s.) Mean changes WST &amp; VAS: <math>\rho = 0.45</math> (<math>P=.025</math>)</p> <p>The changes in total WST and VAS between WSTs 1 and 2 were statistically, but not clinically, significant.</p> <p>There is a slightly negative relationship between total scores on WST 1 and age. There is a significant positive relationship between total WST scores and duration of wheelchair use.</p> <p><u>Rasch Analysis</u> From the 20 skills for which there were sufficient data, by</p>		

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		<p>sequential fitting of the model, 6 skills were dropped, because they added nothing to the model, were not in the same dimension as the other skills, or did not correlate well with them. The remaining 14 skills compromised a unidimensional test of wheelchair ability.</p> <p><u>WST score &amp; occupational therapists global assessment of manual wheelchair skills (Visual Analog Scale (VAS))</u></p> <p>WST 1 &amp; VAS: <math>\rho = 0.40</math> (<math>p=.01</math>)</p> <p>WST 2 &amp; VAS: <math>\rho = 0.54</math> (<math>p=.008</math>)</p>		
<a href="#">Kirby et al.</a> 2004	N=298 (140M, 158F); 129 able bodied, 62	Construct Validity	Interrater – ICC = 0.97	

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Cohort Study to assess measurement properties of the WST 2.4 N=298	amputees, 20 musculoskeletal conditions, 34 SCI, 52 stroke and acquired brain injury. Age for SCI: $41.9 \pm 20.6$ <b>Note: Only 11% SCI</b>	<ul style="list-style-type: none"><li>- Moderate negative correlation with age (<math>r=-0.434</math>, <math>P&lt;0.001</math>)</li><li>- Multiple regression shows age is a significant factor (<math>p&lt;.001</math>)</li><li>- Multiple regression shows gender is a significant factor (<math>p&lt;0.001</math>) (Men = <math>69.2\% \pm 13.2\%</math>, Women = <math>67.8\% \pm 14.5\%</math>)</li></ul> <p>Regarding construct validity, there was a slightly negative Pearson correlation between total WST score and age (<math>-.434</math>). Gender was identified as a significant factor on multiple regression analysis (<math>p&lt;.001</math>). Wheelchair users with more than 21 days of</p>	Intrarater – ICC = 0.96 Test-Retest – ICC = 0.90	



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		experience scored higher than those with less experience (65.0% vs 59.6%; $p=.01$ ). Participants with stroke and related disorders had a mean score (55.0% $\pm$ 13.9%) that was significantly lower than those in other diagnostic categories ( $p<.05$ ). Participants using conventional wheelchairs had lower scores than those in lightweight ones (66.4% vs 75.1%; $p<.001$ ). Regarding concurrent validity, Spearman rank correlations between total WST scores and the 1) subjective evaluation of wheelchair users by their clinicians = 0.39; and 2) admission and		

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		discharge FIM instrument scores were 0.38 and 0.31.		

**Research Summary – Wheelchair Skills Test (WST, WST-Q) – Wheeled Mobility - Cross-cultural Validation Studies**

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<a href="#">Campos al.</a> , 2022  Methodological study of cross- cultural adaptation ( <b>Brazilian Portuguese</b> ) and psychometric properties of reliability of <b>WSTQ for Manual Wheelchairs Operated by Wheelchair Users (WSTQ-M- WCU 4.3)</b>  Research database in the Laboratory of Functional Analysis and	N = 46 38M, 8F Diagnosis: SCI (n = 38), Perinatal diseases (n = 4), Chronic diseases (n = 4) Mean (SD) age 40.23 (13.94) years		The ICC ( <b>inter-rater reliability</b> ) was $r =$ 0.99, $p < .001$ .  <b>Internal consistency:</b> The Cronbach's alpha was 0.96.	<b>Interpretability:</b> Mean scores and 95% confidence interval of SCL-related coping scale and SCL-related psychological measure

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Assistive Technology in a public university located in the Southeast of Brazil				
<a href="#">Passuni et al.</a> 2018  Cross-sectional survey ( <b>Spanish version</b> )	N=11, 10 male Mean age (SD): 29.81 (12.18) years 11 wheelchair users 10 cannot walk, 1 can walk1		Inter-rater reliability: ICC = 0.99	